



Description of the final stadium larva of *Erythrodiplax media* (Odonata: Libellulidae) with preliminary key to known South American larvae in the genus

Marina Schmidt Dalzochio ^{a*}, Eduardo Périco ^a, Samuel Renner ^a and Göran Sahlén ^b

^aLaboratório de Ecologia e Evolução, Universidade do Vale do Taquari – UNIVATES, Lajeado, RS, Brazil; ^bEcology and Environmental Science, The Rydberg Laboratory for Applied Sciences (RLAS), Halmstad University, Halmstad, Sweden

(Received 25 July 2017; final version received 6 March 2018)

The larva of *Erythrodiplax media* is described and illustrated based on two exuviae of reared larvae and one final stadium larva collected in Xangri-lá, State of Rio Grande do Sul, Brazil. The larva of *E. media* can be distinguished from other species of *Erythrodiplax* by the presence of lateral spines on S8 and S9, the number of premental setae ($n = 22$), palpal setae ($n = 7$) and by the mandibular formula. We also provide a preliminary key to known South American larvae in the genus.

Keywords: Brazil; coastal wetlands; dragonfly; exuvia; Anisoptera

Introduction

Erythrodiplax Brauer, 1868 is an American genus that includes 60 species (Schorr & Paulson, 2017), of which 40 are known to occur in Brazil (Pinto, 2017) and 18 are hitherto reported from the state of Rio Grande do Sul (Consatti, Santos, Renner & Périco, 2014; Costa, 1971; Hanauer, Renner & Périco, 2014; Kittel & Engels, 2016; Renner, Périco & Sahlén, 2013, 2016; Renner, Périco, Sahlén, Santos & Consatti, 2015; Teixeira, 1971). The genus consists of many rather similar species, which makes diagnosis difficult. In addition, most larvae in the genus remain undescribed. At present, the final stadium larva has been described for only 27 of the species.

We distinguish *Erythrodiplax* larvae from those of related genera by: (1) lack of long setae on the body (except *E. laselva*); (2) head longer than the thorax; (3) third antennomere longer than the rest of the antenna; (4) mandibles with four incisor teeth but number of molar teeth variable (2 to 4) and lacking a molar crest; (5) distal margin of prementum obtuse and serrated; (6) abdomen without dorsal hooks (some species with mid-dorsal tubercles bearing tufts of setae); (7) epiproct, paraprocts and cerci recurved ventrally, except in *E. umbrata* (Lozano, Muzón & del Palacio, 2011).

Erythrodiplax larvae inhabit shallow, lentic environments such as lakes, ponds and wetlands, and are associated with floating and submerged macrophytes. Two of the species breed in bromeliads (Haber, Wagner & De La Rosa, 2015; Trapero-Quintana & Reyes-Tur, 2008). The

*Corresponding author. Email: mahsdalzochio@gmail.com

genus is bivoltine (Corbet, Suhling, & Soendgerath, 2006), with individuals living 6–9 months as adults (for example *E. fusca* and *E. atroterminata* in Renner et al., 2013). The genus exhibits exophytic oviposition, and the majority of the species are generalist and associated also with degraded environments.

Erythrodiplax media Borror, 1942 has a large range in South America, from Bolivia to Argentina (Heckman, 2006). In Brazil, it is found in Maranhão (De Marco-Junior, 2008) and from Espírito Santo to Rio Grande do Sul (Heckman, 2006). According to our observations, this species was very common and abundant in relation to the majority of other species observed, which corroborates previous studies in southern Brazil (Consatti et al., 2014; Hanauer et al., 2014; Renner et al., 2015, 2016). The aim of this contribution is to give a description of the last stadium larva of *Erythrodiplax media* and to provide a preliminary key to known South American larvae in the genus.

Material and methods

We collected larvae (F-0) from a coastal wetland, Xangri-lá municipality, State of Rio Grande do Sul, Brazil, on 2 February 2017 (29.8107°S, 50.0608°W). The collection site was a wetland located among coastal grasslands and surrounded by houses and roads. The edges of the wetland were dominated by floating and submerged macrophytes, among which we found the larvae (Figure 1).

Two specimens were reared in the laboratory until the emergence of the adult (2♀), according to the methodology of Costa, Pujol-Luz, and Régis (2004). We identified the species by comparing the reared specimens with a mated pair of *Erythrodiplax media* and using the adult characters presented by Garrison, von Ellenrieder, and Louton (2006) and Heckman (2006). At the study sampling site, just two adult *Erythrodiplax* species have been observed and collected: *E. media* (1♂/1♀) and *E. paraguayensis* (2♂/1♀). All final stadium *Erythrodiplax* larvae collected in the site were reared and the same two species emerged: *E. media* (2♀) and *E. paraguayensis* (2♂). We were able to separate all *Erythrodiplax* larvae not emerged from the same site using our exuviae and identified another final stadium larva (1♀) for the measurements. In total, we examined



Figure 1. Larval habitat of *Erythrodiplax media* in Xangri-lá, Rio Grande do Sul, Brazil.

2 exuviae and 1 F-0 larva (♀) for this description. Both larvae and adults (emerged and collected) were preserved in 80% alcohol.

Measurements were taken using a Leica EZ 4 HD stereo microscope (Wetzlar, Germany) using all three specimens and are given in millimeters. The mandibular formula follows Watson (1956). The illustrations were prepared from photos taken with the same equipment and enhanced in Adobe Illustrator CC 2017® (Adobe Systems, CA, USA, Available at: <https://www.adobe.com/>). The voucher specimens were deposited in the collection of Museu de Ciências da Univates (MCN), Lajeado, State of Rio Grande do Sul, Brazil. We used the following abbreviations: ♂ = male individuals; ♀ = female individuals; S1–S10 = abdominal segments; F0 = final stadium; FW = forewings; HW = hind wings; L = length; W = width.

Results

Erythrodiplax media Borror, 1942

Figures 2–6

Color pattern. Head brown with dark markings around bases of antennae and a reticulated pattern on the dorsum laterally to the eyes. Dark spots on occiput (Figure 3a). Labium brown with a yellow tinge and with black spots randomly distributed on inner surface of labial palp. Thorax brown with a black marking along middorsal line (Figure 3b). Legs brown, femora with two annular blackish bands, one subbasal and one subapical. Abdomen brown, with two wide black stripes on each side of middorsal line from S6 to base of epiproct, covering roughly half the surface of the abdomen. In each of these stripes there are large pale spots on S8 and S9. Anal appendages dark. Paired, elongated black spots on ventral side of the abdomen from S1 to S7 (Figure 2b).



Figure 2. F-0 stadium larva of *E. media*: (a) overview; (b) abdomen, with dark spots in ventral view.

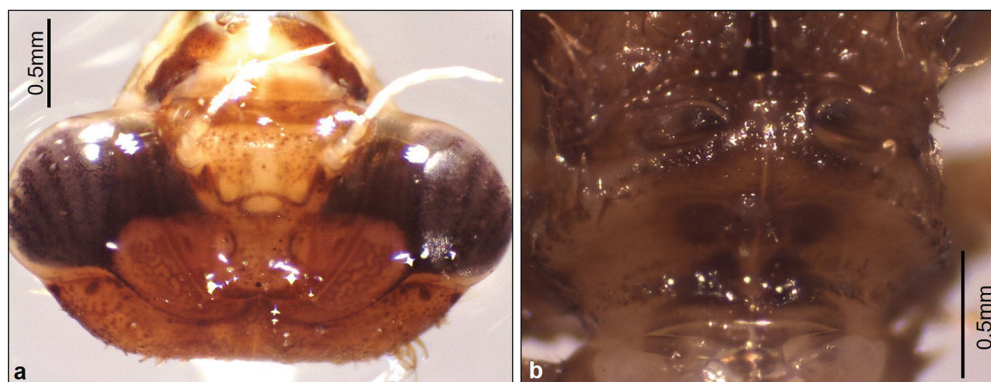


Figure 3. (a) Marks on head; (b) color patterns on thorax.

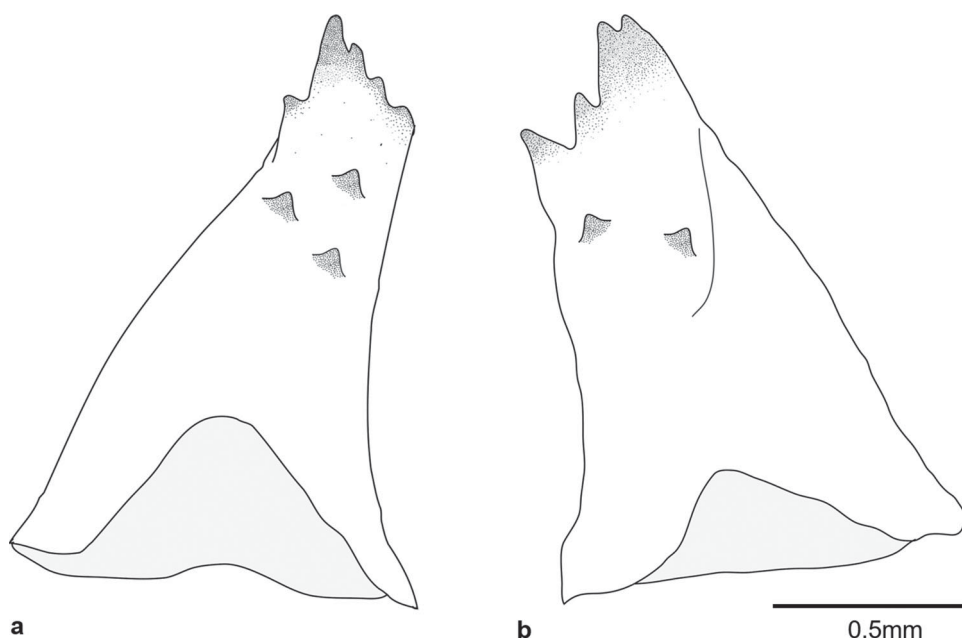


Figure 4. (a) Right mandible, inner view; (b) left mandible, inner view.

Head. Pale and robust setae on occipital portion and black hair-like setae on vertex and occiput. Head 1.96 times as wide as long and mid-part of occipital margin slightly concave. Mandibular formula: right 1234yabd (Figure 4a); left 1234ab (Figure 4b). Labial hinge reaching basal margin of mesothoracic coxae when retracted. Prementum (Figure 5a) with distal margin of ligula obtuse and serrated with 22 small setae increasing in size from base to top, plus two apical setae; 22 premental setae (11 + 11); lateral margin without setae; three short and thick premental setae (“premental spines”) at labial palp articulation (Figure 5b). Labial palp (Figure 5c) with one small seta at base, seven setae and one hook; anterior margin slightly crenulated with 10 spiniform setae, one on each concavity; inner margin with 10 spiniform setae.

Thorax. Lateral margin of prothorax, synthorax and the edge of wing pads covered with long setae. Middorsal area of thorax without setae. Wing pads reaching posterior margin of S6 in

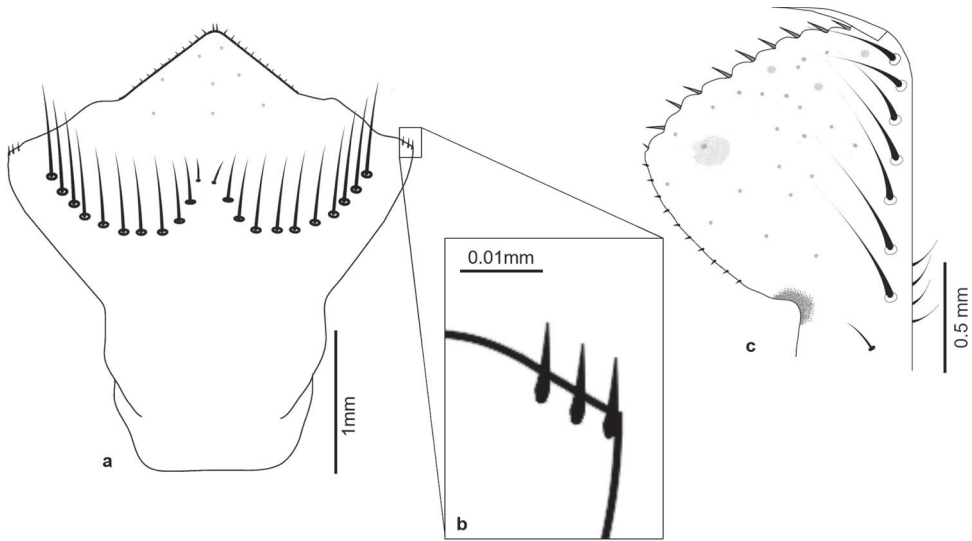


Figure 5. (a) Prementum, flattened, dorsal view; (b) premental spines – small, thick spines at labial palp articulation; (c) right labial palp, natural shape, dorsal view.

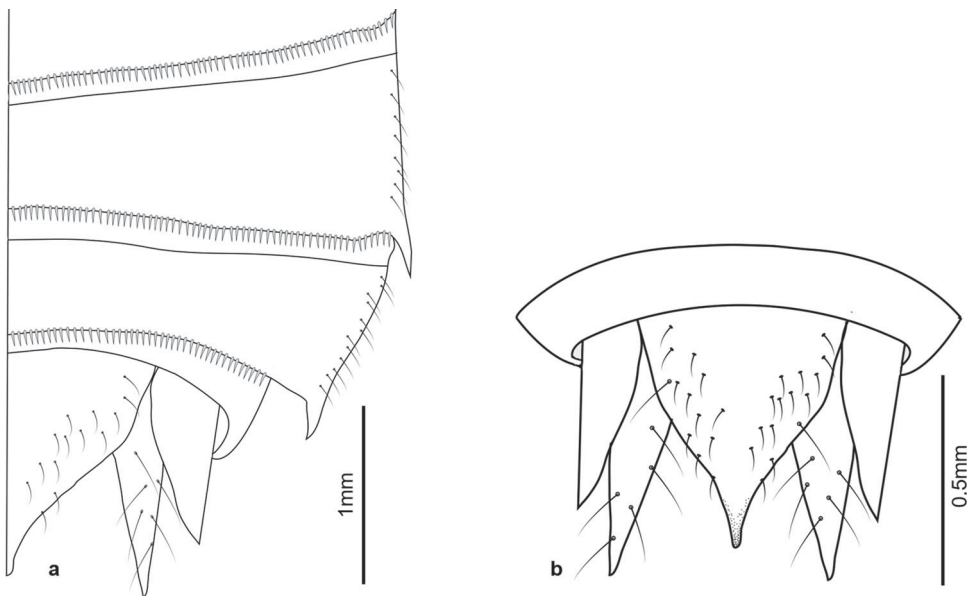


Figure 6. (a) Lateral spines on S8–9; (b) anal appendages, dorsal view.

exuviae and S7 in the final stadium larva. Vein marks on wing pads outlined by long setae. Legs long (i.e. hind legs when fully extended twice length of total length of abdomen), coxa and trochanter bare, femur with spiniform setae diffuse on dorsal and ventral ridge. Tibia covered by long setae and its dorsal ridge covered by strong spiniform setae. Apical margin of tibia in ventral view with single, robust spiniform seta. Tibia 1.18 times longer than femora. Tarsus with hair-like setae on dorsum. Tarsal claws as long as 2/3 of 3rd tarsal segment.

Abdomen. Oval, widest at S5 to S7. Short sparse setae on dorsum, distributed in a random pattern. Along apical margin of each tergite, from S5 to S9, a dense row of spiniform setae

(Figure 6a). Setae absent on ventral surface of abdomen. Lateral carina distinctive in ventral view, where spiniform setae are also present but not as dense as dorsally. Lateral spines present from S8 to S9 and covered by spiniform setae. Ratio of S8 and S9 lateral spine L to maximum L of corresponding segments 0.41:1 (average of three individuals) and 0.34:1, respectively (Figure 6a). Tips of anal appendages slightly recurved and covered by setae. Epiproct wide at base, apex acute. Epiproct 0.9 times L of paraproct. Cercus 0.74 times L of paraproct and 0.81 times L of epiproct (Figure 6b).

Measurements (mean: minimum/maximum). Total body L (including paraprocts): 11.47: 11.36/11.54. Head maximum W: 3.18: 2.99/3.45. Head maximum L: 1.62: 1.54/1.68. Prementum maximum W: 3.07: 3.04/3.10. Prementum maximum L: 2.82: 2.81/2.84. Labial palp maximum W: 1.13: 1.09/1.16. Labial palp maximum L: 1.51: 1.43/1.60. Movable hook L: 0.47: 0.46/0.48. Femur 3 L: 2.54: 2.52/2.57. Tibia 3 L: 3.02: 2.97/3.07. FW pads L: 3.55: 3.37/3.68. Mid-dorsal L of abdominal tergum S6: 0.69: 0.63/0.73; S7: 0.64: 0.56/0.72; S8: 0.51: 0.45/0.56; S9: 0.5: 0.45/0.53; S10: 0.20: 0.19/0.22. Lateral spines on S8: 0.21: 0.20/0.22; on S9: 0.17: 0.15/0.19. Abdomen maximum W: 3.87: 3.60/4.09. Abdomen maximum L: 5.50: 5.23/5.65. Cercus L: 0.51: 0.45/0.55. Paraproct L: 0.69: 0.60/0.72. Epiproct L: 0.62: 0.58/0.68.

Preliminary key to known final stadium larvae of South American Erythrodiplax

1. No lateral spines 2
- 1'. Lateral spines present 3
2. 18 premental setae *amazonica*
(Guyana, French Guiana, Peru, Venezuela, Brazil)
- 2'. Less than 15 premental setae *connata*
(Colombia, Venezuela, Ecuador, Peru, Argentina, Chile)
3. Lateral spines on S7–9 4
- 3'. Lateral spines on S8–9 5
4. 12 crenulations on labial palp *anomala*
(Argentina, Brazil)
- 4'. 10 crenulations on labial palp *lygaea*
(Argentina, Brazil)
5. 8–9 premental setae 6
- 5'. At least 10 premental setae, rarely 9 7
6. No dorsal protuberances on abdominal segments. 3 premental spines (at labial palp articulation), ligula with 7 setae in each side of prementum and 11 crenulations on labial palp *pallida*
(Argentina, Brazil)
- 6'. No dorsal protuberances on abdominal segments. 2 premental spines, ligula with 8 setae in each side of prementum and 10 crenulations on labial palpana *ana*
(Brazil)
- 6''. Dorsal protuberances in the middle of each abdominal segment. Prementum and palps combinations different *naeva*
(Colombia, Venezuela)
7. Anal appendages straight, 13, 14 or 15 premental setae *umbrata*
(Colombia, Guyana, French Guiana, Surinam, Venezuela, Peru, Ecuador, Paraguay, Bolivia, Uruguay, Argentina, Brazil)

- 7'. Anal appendages recurved ventrally, 10 to 13 premental setae, rarely 9 8
8. Crenulations on labial palp absent *nigricans*
(**Argentina, Uruguay, Paraguay, Brazil**)
- 8'. Crenulations on labial palp present. 9
9. 6 palpal setae 10
- 9'. 7–10 palpal setae 13
10. 12 premental setae *transversa*
(**Venezuela, Guyana**)
- 10'. 10–11 premental setae 11
11. 7 crenulations on labial palp *fervida*
(**Colombia, Venezuela, Guyana, French Guiana, Surinam**)
- 11'. 10 crenulations on labial palp 12
12. Lateral spine of S9 reaching distal margin of cercus *latimaculata*
(**Venezuela, Guyana, Argentina, Bolivia, Brazil**)
- 12'. Lateral spine of S9 shorter than cercus *basalis*
(**Colombia, Venezuela, Peru, Ecuador, Guyana, French Guiana, Brazil**)
13. 7 palpal setae 14
- 13'. 8–10 palpal setae 18
14. 9 crenulations on labial palp *corallina*
(**Argentina, Uruguay, Chile**)
- 14'. 10 or more crenulations on labial palp 15
15. 10 premental setae *paraguayensis* (in part)
- 15'. 11 premental setae 16
- 15''. 12 premental setae 17
16. 2 premental spines *melanorubra*
(**Venezuela, Colombia, Ecuador, Peru, Chile, Argentina, Bolivia, Paraguay, Brazil**)
- 16'. 3 premental spines *media*
(**Bolivia, Paraguay, Argentina, Brazil**)
17. 2 premental spines *ochracea*
(**Colombia, Peru, Guyana, French Guiana, Surinam, Argentina, Paraguay, Bolivia, Brazil**)
- 17'. 3 premental spines *atroterminata*
(**Chile, Argentina, Paraguay, Uruguay, Brazil**)
18. Lateral spines on S8 and S9 half the L of corresponding segment (short) 19
- 18'. Lateral spines on S8 and S9 almost of the same L as corresponding segment (long) *fusca*
(**Colombia, Ecuador, Peru, Venezuela, Guyana, French Guiana, Surinam, Bolivia, Paraguay, Uruguay, Argentina, Brazil**)
19. 1 seta in each labial palp crenulation 20
- 19'. 3–4 setae in each labial palp crenulation *berenice*
(**Venezuela, Colombia**)
20. 8 palpal setae *paraguayensis* (in part)
(**Ecuador, Venezuela, Guyana, Surinam, Bolivia, Paraguay, Argentina, Brazil**)
- 20'. 9–10 palpal setae *juliana/funerea**
E. juliana* (Colombia, Peru, Venezuela, Bolivia, Brazil**)
E. funerea* (Colombia, Ecuador**)

Table 1. Morphological characters from known *Erythrodiplax* larvae.

Species		Left mandible	Right mandible	Premental setae	Premental spines	Ligula setae	Palpal setae
<i>E. amazonica</i>	Sjöstedt, 1918	?	?	18	?	?	10
<i>E. ana</i>	Guilhermo-Ferreira, Vilela Del-Claro & Bispo, 2016	12340ab	1234yabd	9	2	8	6
<i>E. anomala</i>	(Brauer, 1865)	1234yab	1234yabc-d	11/12	2	13	7
<i>E. atroterminata</i>	Ris, 1911	12340ab	1234yabc	12	3	9	7
<i>E. basalis</i>	Kirby, 1897	12340ab	1234yabc	10	2	9	6
<i>E. basifusca</i>	(Calvert, 1895)	12340ab	1234yabd	11	4	13	7
<i>E. berenice</i>	(Drury, 1773)	?	?	10/11	?	?	9/10
<i>E. bromellicola</i>	Westfall, 2000	1234yab	1234yabd	9/10/11	3	8-10	7
<i>E. connata</i>	(Rambur, 1842)	1234oab	1234yabd	11/12/13	3	10	7
<i>E. corallina</i>	(Brauer, 1865)	12340ab	1234yab	11/12	4	9	7
<i>E. fervida</i>	Erichson, 1848	1234yab	1234yabcd	10	2	7	6
<i>E. funerea</i>	(Hagen, 1861)	?	?	10/11	?	?	9/10
<i>E. fusca</i>	(Rambur, 1842)	1234	1234	9/10/11	3	7	8
<i>E. juliana</i>	Ris, 1911	11'2340ab	1234yabc-d	11/12	3	12	9
<i>E. justiniana</i>	(Selys in Sagra, 1857)	?	?	10	12/13	?	7/9/10
<i>E. laselva</i>	Haber, Wagner & De La Rosa, 2015	1234	1234yabd	12	2/3	0	9
<i>E. latimaculata</i>	Ris, 1911	12340ab	1234yabc	10	2	8	6
<i>E. lygaea</i>	Ris, 1911	1234yab	?	10	?	?	6
<i>E. media</i>	Borror, 1942	12340ab	1234yabd	11	3	12	7
<i>E. melanorubra</i>	Borror, 1942	?	?	11	2	6-8	7
<i>E. minuscula</i>	(Rambur, 1842)	12340ab	1234yabd	12	4	11	7
<i>E. naeva</i>	(Hagen, 1861)	?	?	8/9	?	?	6/7/8
<i>E. nigricans</i>	(Rambur, 1842)	12340ab	1234yabc	11/12/13	3	?	8/9
<i>E. ochracea</i>	(Burmeister, 1839)	1234yabb'	1234yabcd	12	2	16	7
<i>E. pallida</i>	(Needham, 1904)	1234ya	12340abc	9	3	7	6
<i>E. paraguayensis</i>	(Förster, 1905)	12340ab	1234yabd	10	2	9	7/8
<i>E. transversa</i>	Borror, 1957	?	?	12	2/3	8	6
<i>E. umbrata</i>	Linnaeus, 1758	12340a	1234yabc	13/14/15	3	11	12

(Continued)

Table 1. Continued

Species		Number of crenulations	Setae in each crenulations	Lateral spines	Total body length	Greatest width of head	References
<i>E. amazonica</i>	Sjöstedt, 1918	0	0	0	14.00	4.60	De Marmels, 1992a
<i>E. ana</i>	Guilhermo-Ferreira et al., 2016	10	1	8/9	13.00	3.40	Guilhermo-Ferreira et al., 2016
<i>E. anomala</i>	(Brauer, 1865)	12	1	7/8/9	11.97	3.88	Carvalho, Ferreyra & Nessimian, 1991
<i>E. atroterminata</i>	Ris, 1911	10	1	8/9	?	4.00	Garré, Muzón, & Ardohain, 2008
<i>E. basalis</i>	Kirby, 1897	10	1	8/9	12.50	3.50	Costa, Vieira & Lourenço, 2001
<i>E. basifusca</i>	(Calvert, 1895)	14	1	8/9	12.64	3.97	Lozano et al., 2011
<i>E. berenice</i>	(Drury, 1773)	?	3/4	8/9	14.25	?	von Ellenrieder & Múzon, 2000
<i>E. bromellicola</i>	Westfall, 2000	10/11	1	8/9	12.02	4.29	Trapero-Quintana & Novelo-Gutierrez, 2012
<i>E. connata</i>	(Rambur, 1842)	14-19	1	0	13.34	4.11	Lozano et al., 2011
<i>E. corallina</i>	(Brauer, 1865)	9	1	8/9	?	4.78	Garré et al., 2008
<i>E. fervida</i>	Erichson, 1848	7	1	8/9	11.50	?	Trapero-Quintana & Reyes-Tur, 2008
<i>E. funerea</i>	(Hagen, 1861)	?	1	8/9	14.00	?	von Ellenrieder & Múzon, 2000
<i>E. fusca</i>	(Rambur, 1842)	11-15	1	8/9	10.00	4.00	Klots, 1932 ; Santos, 1967
<i>E. juliana</i>	Ris, 1911	11	1	8/9	12.20	3.88	Carvalho et al., 1991
<i>E. justiniana</i>	(Selys in Sagra, 1857)	10	1	8/9	10.50	4.30	Klots, 1932 ; Trapero-Quintana & López, 2009
<i>E. laselva</i>	Haber, Wagner & De La Rosa, 2015	0	0	0	?	4.50	Haber, Wagner & De La Rosa, 2015
<i>E. latimaculata</i>	Ris, 1911	10	1	8/9	11.20	3.50	Costa et al., 2001
<i>E. lygaea</i>	Ris, 1911	10	1	7/8/9	?	?	Costa et al., 2001
<i>E. media</i>	Borror, 1942	10	1	8/9	11.47	3.18	Present study
<i>E. melanorubra</i>	Borror, 1942	10/11	1	8/9	13.00	4.00	Limongi, 1991
<i>E. minuscula</i>	(Rambur, 1842)	11	1	8/9	11.50	3.73	Lozano et al., 2011
<i>E. naeva</i>	(Hagen, 1861)	11/12	3/4	8/9	14.00	?	Klots, 1932 ; Trapero-Quintana & López, 2009
<i>E. nigricans</i>	(Rambur, 1842)	0	9	8/9	?	4.10	von Ellenrieder & Múzon, 2000
<i>E. ochracea</i>	(Burmeister, 1839)	11	1	8/9	13.33	4.33	Carvalho et al., 1991
<i>E. pallida</i>	(Needham, 1904)	11	1	8/9	12.00	3.00	Costa et al., 2001
<i>E. paraguayensis</i>	(Förster, 1905)	10/11	1	8/9	?	3.50	Muzon & Garré, 2005
<i>E. transversa</i>	Borror, 1957	11	2/3	8/9	14.00	4.80	De Marmels, 1992b
<i>E. umbrata</i>	Linnaeus, 1758	11/12/13	2/3	8/9	14.92	4.14	Costa et al., 2001

Discussion

We note that all hitherto described larvae of the genus *Erythrodiplax* are very similar in metric and morphological characters (Table 1), making the distinction of species very difficult (Lozano, Muzón & del Palacio, 2011; von Ellenrieder & Muzón, 2000). Some characters described as important to diagnose the genus *Erythrodiplax* are also variable in other Libellulidae (i.e. premental and palpal setae), highlighting the great need for further studies involving *Erythrodiplax* larvae as well as related genera. We believe that characters like premental spines, number of setae in each crenulation, setae on the ligula and mandibular formula can be important characters for the separation of species, but unfortunately many of the previous descriptions do not include all these characters. As we based our description on female larvae only, there are still issues concerning the verification of the species identity. Although we deem it very likely that no other than the two sampled species occur in the habitat, the collection and hatching of male larvae from the site would be desirable.

It was quite difficult to accurately separate the larvae of *E. media* and *E. fusca*, since even the adults are cryptic and the characters indicated for the larva in the descriptions of Klots (1932) and Santos (1967) are meager. However, our specimens of *E. media* have 7 setae on the labial palp and 12 setae on the ligula, while *E. fusca* has 8–10 setae on the labial palp and only 7 setae on the ligula. *E. media* is also very much related to *E. melanorubra*, with the same ecological habits. We examined larvae of both species and the only difference is in the number of premental spines. More studies are needed to ascertain a clear separation of these species as larvae. All the descriptions above, including ours, are based on a limited number of individuals, so we assume that more variation in spine numbers should exist, but at present we do not know to what extent.

With the description of the larva of *Erythrodiplax media*, all of the more abundant/common *Erythrodiplax* species occurring in Brazil and other areas of South America are described as larvae. The other common species, *E. atroterminata*, *E. fusca*, *E. melanorubra*, *E. ochracea*, *E. paraguayensis*, and *E. umbrata*, all occur in a wide range of water bodies, typical for generalist species with wide niches (e.g. Carvalho, Pinto, Oliveira Júnior, & Juen, 2013; Renner et al., 2016). We collected *E. media* in a wetland surrounded by areas of human development. We can assume that as this species is generalist, its larvae will be found in many other types of water bodies. Indeed, data from Renner, Périco, Dalzochio, and Sahlén (2017) note the presence of adult *E. media* in rivers, streams, farmland dams and temporary water. Most of the localities surveyed were surrounded by grassland or crop plantations, but forest cover could be up to 50% in some cases. Thus, *E. media* seems to be a very tolerant species when selecting suitable habitats for reproduction, but available data indicate that it is foremost an open area species.

Acknowledgements

We are grateful to Universidade do Vale do Taquari (UNIVATES) for provided logistical support and to our field assistants Cleber Sganzerla and Gabriel Prass, who gave commendable assistance in our sampling efforts, as well as SisBio and IBAMA for the collecting permit.

Funding

This research was supported by CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) through a postdoctoral fellowship (to MSD) and a Professor Visitante do Exterior (PVE) cooperation program between UNIVATES and Halmstad University [88881.068147/2014-01 #1] and by FAPERGS (Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul, [PROBIC/2016, #2]).

ORCID

Marina Schmidt Dalzochio  <http://orcid.org/0000-0001-9241-921X>

Eduardo Périco  <http://orcid.org/0000-0002-2926-6246>

Samuel Renner  <http://orcid.org/0000-0001-8700-6031>

Göran Sahlén  <http://orcid.org/0000-0002-7840-6460>

References

- Carvalho, A. L., Ferreyra, N., Jr., & Nessimian, J. L. (1991). Descrição das larvas de três espécies do gênero *Erythrodiplax* Brauer (Odonata, Libellulidae). *Revista Brasileira de Entomologia*, 35, 165–171.
- Carvalho, F. G. D., Pinto, N. S., Oliveira Júnior, J. M. B., & Juen, L. (2013). Effects of marginal vegetation removal on Odonata communities. *Acta Limnologica Brasiliensia*, 25, 10–18.
- Consatti, G., Santos, D. M., Renner, S., & Périco, E. (2014). Presença de Odonata em Áreas Preservadas e Não Preservadas nas Matas Ciliares do Rio Taquari, Rs. *Revista de Iniciação Científica da ULBRA*, 1, 57–65.
- Corbet, P. S., Suhling, F., & Soendergerath, D. (2006). Voltinism of Odonata: A review. *International Journal of Odonatology*, 9, 1–44.
- Costa, J. M. (1971). Contribuição ao conhecimento da fauna odonitológica do município de Santa Maria, Rio Grande do Sul. *Atas da Sociedade Biológica Rio de Janeiro*, 14, 193–194.
- Costa, J. M., Pujol-Luz, J., & Régis, L. L. P. B. (2004). Descrição da larva de *Zenithoptera anceps* (Odonata, Libellulidae). *Iheringia, Série Zoologia*, 94, 421–424.
- Costa, J. M., Vieira, L. P., & Lourenço, A. N. (2001). Descrição de três larvas de *Erythrodiplax* Brauer, 1868, e redescricao das larvas de *E. pallida* (Needham, 1904) e *E. umbrata* (Linnaeus, 1758), com chave para identificação das larvas conhecidas das espécies brasileiras (Odonata, Libellulidae). *Boletim do Museu Nacional*, 465, 1–16.
- De Marco-Junior, P. (2008). Libellulidae (Insecta: Odonata) from Itapiracó reserve, Maranhão, Brazil: New records and species distribution information. *Acta Amazonica*, 38, 819–822.
- De Marmels, J. (1992a). Caballitos del Diablo (Odonata) de las sierras de Tapirapeco y Unturan, en el Extremo Sul de Venezuela. *Acta Biologica Venezuelica*, 14, 57–78.
- De Marmels, J. (1992b). Odonata del Cerro Guaiquinima (Edo. Bolívar) y zonas aledañas. *Boletín de Entomología Venezolana*, 7, 37–47.
- Garré, A., Muzón, J., & Ardohain, D. M. (2008). Description of the final instar larvae of *Erythrodiplax atroterminata* Ris and *E. corallina* (Brauer) (Odonata: Libellulidae). *Zootaxa*, 1896, 45–50.
- Garrison, R. W., von Ellenrieder, N., & Louton, J. (2006). *Dragonfly genera of the new world*. Baltimore: The Johns Hopkins University Press.
- Guilherme-Ferreira, R., Vilela, D. S., Del-Claro, K., & Bispo, P. C. (2016). *Erythrodiplax ana* sp. nov. (Odonata: Libellulidae) from Brazilian palm swamps. *Zootaxa*, 4158(2), 292–300.
- Haber, W. A., Wagner, D. L., & De La Rosa, C. (2015). A new species of *Erythrodiplax* breeding in bromeliads in Costa Rica (Odonata: Libellulidae). *Zootaxa*, 3947, 386–396.
- Hanauer, G., Renner, S., & Périco, E. (2014). Inventariamento Preliminar da Fauna de Libélulas (Odonata) em Quatro Municípios do Vale do Taquari/Rs. *Revista Destaques Acadêmicos*, 6, 36–45.
- Heckman, C. W. (2006). *Encyclopedia of South American aquatic insects: Odonata-Anisoptera: Illustrated keys to known families, genera, and species in South America*. New York City, NY: Springer Science & Business Media.
- Kittel, R. N., & Engels, W. (2016). Diversity of dragonflies (Odonata: Anisoptera) of Rio Grande do Sul, Brazil, with five new records for the state. *Notulae odonatologicae*, 8, 247–318.
- Klots, E. B. (1932). Insects of Puerto Rico and the Virgin Islands: Odonata or dragonflies. *Scientific Survey of Porto Rico*, 14, 1–107.
- Limongi, J. (1991). Estúdio morfo-taxonomico de nayades de algunas especies de Odonata en Venezuela. 2. *Memorias de la Sociedad de Ciencias Naturales La Salle*, 49/50, 405–420.
- Lozano, F., Muzón, J., & del Palacio, A. (2011). Description of final stadium larva of *Erythrodiplax connata* and *E. basifusca* and redescription of that of *E. minuscula* (Odonata: Libellulidae). *International Journal of Odonatology*, 14, 127–135.
- Muzón, J., & Garré, A. (2005). Descripción del último estadio larval de *Erythrodiplax paraguayensis* (Anisoptera: Libellulidae). *Revista de la Sociedad Entomológica Argentina*, 64, 85–91.
- Pinto, A. P. (2017). *Libellulidae in Catálogo Taxonômico da Fauna do Brasil*. PNUD. Retrieved from <http://fauna.jbrj.gov.br/fauna/faunadobrasil/7859>
- Renner, S., Périco, E., Dalzochio, M. S., & Sahlén, G. (2017). Water body type and land cover shape the dragonfly communities (Odonata) in the Pampa biome, Rio Grande do Sul, Brazil. *Journal of Insect Conservation*, 22, 113–125.
- Renner, S., Périco, E., & Sahlén, G. (2013). Dragonflies (Odonata) in subtropical Atlantic Forest fragments in Rio Grande do Sul, Brazil: Seasonal diversity and composition. *Scientia Plena*, 9, 1–8.
- Renner, S., Périco, E., & Sahlén, G. (2016). List of odonates from the Floresta Nacional de São Francisco de Paula (FLONA - SFP), with two new distribution records for Rio Grande do Sul, Brazil. *Biota Neotropica*, 16, 1–7.
- Renner, S., Périco, E., Sahlén, G., dos Santos, D. M., & Consatti, G. (2015). Dragonflies (Odonata) from the Taquari River valley region, Rio Grande do Sul, Brazil. *Check List*, 11, 1740.
- Santos, N. D. (1967). Notas sobre a ninfa de *Erythrodiplax connata fusca* (Rambur, 1842) Brauer, 1868 (Odonata, Libellulidae). *Atas da Sociedade de Biologia do Rio de Janeiro*, 10, 145–147.

- Schorr, M., & Paulson, D. (2017). *World Odonata list*. Last revision: May 30, 2017. Retrieved from <https://www.pugetsound.edu/academics/academic-research/sources/slater-museum/biodiversity-resources/dragonflies/world-odonata-list2/>
- Teixeira, M. C. (1971). Contribuição para o conhecimento da fauna odonitológica do Rio Grande do Sul. *Arquivos do Museu Nacional do Rio de Janeiro*, 54, 19–24.
- Trapero-Quintana, A., & López, C. N. (2009). Clave para la identificación de especies de Odonata en estado larval de Cuba. *Boletín Sociedad Entomológica Aragonesa*, 44, 459–467.
- Trapero-Quintana, A. D., & Novelo-Gutierrez, R. (2012). Description of the final stadium larva of *Erythrodiplax bromeliicola* Westfall, 2000 (Odonata: Libellulidae) with notes on variation in adults from Cuba. *Zootaxa*, 3545, 59–66.
- Trapero-Quintana, A. D., & Reyes-Tur, B. (2008). Description of the last instar larva of *Erythrodiplax fervida* (Erichson, 1848) (Anisoptera: Libellulidae), with notes on the biology of the species. *Zootaxa*, 1688, 66–68.
- von Ellenrieder, N., & Muzón, J. (2000). Description of the last instar larva of *Erythrodiplax nigricans*. *Odonatologica*, 29, 267–272.
- Watson, M. C. (1956). The utilization of mandibular armature in taxonomic studies of anisopterous nymphs. *Transaction of the American Entomological Society*, 81, 155–202.